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MOLECULAR BIOLOGY OF
THE CELL

fourth edition

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Front cover Human Genome: Reprinted by permission from *Nature*, International Human Genome Sequencing Consortium, 409:860-921, 2001 © Macmillan Magazines Ltd. Adapted from an image by Francis Collins, NHGRI; Jim Kent, UCSC; Ewan Birney, EBI; and Darryl Leja, NHGRI; showing a portion of Chromosome 1 from the initial sequencing of the human genome.

Back cover In 1967, the British artist Peter Blake created a design classic. Nearly 35 years later Nigel Orme (illustrator), Richard Denyer (photographer), and the authors have together produced an affectionate tribute to Mr Blake's image. With its gallery of icons and influences, its assembly created almost as much complexity, intrigue and mystery as the original. *Drosophila*, *Arabidopsis*, Dolly and the assembled company tempt you to dip inside where, as in the original, "a splendid time is guaranteed for all." (Gunter Blobel, courtesy of The Rockefeller University; Marie Curie, Keystone Press Agency Inc; Darwin bust, by permission of the President and Council of the Royal Society; Rosalind Franklin, courtesy of Cold Spring Harbor Laboratory Archives; Dorothy Hodgkin, © The Nobel Foundation, 1964; James Joyce, etching by Peter Blake; Robert Johnson, photo booth self-portrait early 1930s, © 1986 Delta Haze Corporation all rights reserved, used by permission; Albert L. Lehninger, (unidentified photographer) courtesy of The Alan Mason Chesney Medical Archives of The Johns Hopkins Medical Institutions; Linus Pauling, from Ava Helen and Linus Pauling Papers, Special Collections, Oregon State University; Nicholas Poussin, courtesy of ArtToday.com; Barbara McClintock, © David Micklos, 1983; Andrei Sakharov, courtesy of Elena Bonner; Frederick Sanger, © The Nobel Foundation, 1958.)

cyclic AMP (cAMP)

Nucleotide that is generated from ATP by adenyl cyclase in response to stimulation of many types of cell-surface receptors. cAMP acts as an intracellular signaling molecule by activating cyclic-AMP-dependent kinase (protein kinase A, PKA). It is hydrolyzed to AMP by a phosphodiesterase.

cyclic AMP-dependent protein kinase (protein kinase A, PKA)

Enzyme that phosphorylates target proteins in response to a rise in intracellular cyclic AMP.

cyclic GMP

Small soluble intracellular signaling molecule formed from GTP by the enzyme guanylyl cyclase in response to photoreceptor stimulation in the retina.

cyclin

Protein that periodically rises and falls in concentration in step with the eucaryotic cell cycle. Cyclins activate crucial protein kinases (called a cyclin-dependent protein kinase, or Cdk) and thereby help control progression from one stage of the cell cycle to the next.

cyclin-Cdk complex

Protein complexes that are formed periodically during the eucaryotic cell cycle as the level of cyclin increases, and in which the cyclin-dependent kinase (Cdk) becomes partially activated.

cyclin-dependent kinase (Cdk)

Protein kinase that has to be complexed with a cyclin protein in order to act. Different Cdk-cyclin complexes trigger different steps in the cell-division cycle by phosphorylating specific target proteins.

cytochrome *b-c*₁ complex

Second of the three electron-driven proton pumps in the respiratory chain. It accepts electrons from ubiquinone.

cytochrome oxidase complex

Third of the three electron-driven proton pumps in the respiratory chain. It accepts electrons from cytochrome *c* and generates water using molecular oxygen as an electron acceptor.

cytochrome

Colored, heme-containing protein that transfers electrons during cellular respiration and photosynthesis.

cytokine

Extracellular signal protein or peptide that acts as a local mediator in cell-cell communication.

cytokine receptor

Type of cell-surface receptor whose ligands are cytokines such as interferons, growth hormone and prolactin, and which acts through the Jak-STAT pathway.

cytokinesis

Division of the cytoplasm of a plant or animal cell into two, as distinct from the division of its nucleus (which is mitosis).

cytoplasm

Contents of a cell that are contained within its plasma membrane but, in the case of eucaryotic cells, outside the nucleus.

cytoskeleton

System of protein filaments in the cytoplasm of a eucaryotic cell that gives the cell shape and the capacity for directed movement. Its most abundant components are actin filaments, microtubules, and intermediate filaments.

cytosol

Contents of the main compartment of the cytoplasm, excluding membrane-bounded organelles such as endoplasmic reticulum and mitochondria. Originally defined operationally as the cell fraction remaining after membranes,

cytoskeletal components, and other organelles have been removed by low-speed centrifugation.

cytotoxic T cell

Type of T cell responsible for killing infected cells.

 ΔG° —see standard free-energy change **ΔG —see free-energy change****dalton**

Unit of molecular mass. Approximately equal to the mass of a hydrogen atom (1.66×10^{-24} g).

default pathway

Constitutive secretory pathway that automatically delivers material from the Golgi apparatus to the plasma membrane if no other sorting signals are present.

degenerate

Not a moral judgment but an adjective that describes multiple states that amount to the same thing: different triplet combinations of nucleotide bases (codons) that code for the same amino acid, for example.

deletion

Type of mutation in which a single nucleotide or sequence of nucleotides has been removed from the DNA.

denaturation

Dramatic change in conformation of a protein or nucleic acid caused by heating or by exposure to chemicals and usually resulting in the loss of biological function.

dendrite

Extension of a nerve cell, typically branched and relatively short, that receives stimuli from other nerve cells.

dendritic cell

Cell derived from bone marrow and present in lymphoid and other tissues that is specialized for the uptake of particulate material by phagocytosis and which acts as a "professional" antigen-presenting cell in immune responses.

deoxyribonucleic acid—see DNA**desensitization—see adaptation****desmosome**

Type of anchoring cell-cell junction, usually formed between two epithelial cells, characterized by dense plaques of protein into which intermediate filaments in the two adjoining cells insert.

detergent

Type of small amphipathic molecule that tends to coalesce in water, with its hydrophobic tails buried and its hydrophilic heads exposed. It is widely used to solubilize membrane proteins.

determined

In developmental biology, an embryonic cell is said to be determined if it has become committed to a particular specialized path of development. This **determination** reflects a change in the internal character of the cell, and it precedes the much more readily detected process of cell differentiation.

development

Succession of changes that take place in an organism as a fertilized egg gives rise to an adult plant or animal.

diacylglycerol

Lipid produced by the cleavage of inositol phospholipids in response to extracellular signals. Composed of two fatty acid chains linked to glycerol, it serves as a signaling molecule to help activate protein kinase C.